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Intestinal Parasites Isolated from Some Vegetables Sold in Ado-Ekiti Market, Ekiti State, Nigeria

Intestinal Parasites found in Ado-Ekiti Market Vegetables

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Abstract
Objective: There is a reported association between contaminated fresh vegetables and food-borne parasitic diseases. Intestinal parasite infections are a global public health threat.
Methodology: A cross-sectional study was conducted between May and June 2023 to identify parasites in common vegetables from markets in Ado-Ekiti, Ekiti State, Nigeria. A total of 120 vegetable samples from four markets were examined. The vegetables were washed separately in 150 ml of normal saline to remove parasitic ova, larvae, or cysts. After discarding the vegetables, the residue was left overnight, sieved, and the suspension was centrifuged at 2,000 rpm for five minutes. The sediment was examined under a light microscope using ×10 and ×40 objectives.
Results: Out of the 120 samples examined, 78 (65%) of the vegetables were positive for intestinal parasites with which Ewedu leaf (*Corchorus olitorius*) recorded the highest parasitic contamination with 30 (38.5%). In contrast, Uziza leaf (*Piper guineense*) and Carrot (*Daucus carota*) recorded the lowest parasite contamination 4 (5.1%). Seven different types of parasites were isolated from 120 vegetables from 4 different markets; these parasites include *Strongyloides stercoralis* 34 (43.6%), Gardia lamblia 20 (25.6%), *Ascaris lumbricoides* 8 (10.3%), Hookworm 6 (7.7%), *Entamoeba histolytica* 4 (5.1%), *Balantidium coli* 4 (5.1%) and *Trichuris trichuria* 2 (2.6%).
Conclusion: Vegetables from selected markets in Ado-Ekiti were contaminated with significant parasites, posing disease transmission risks. Enhanced hygiene practices among farmers, consumers, and vendors are crucial to reducing intestinal parasite infections.

Keywords: Vegetables, Intestinal parasites, Contaminations, Markets, Ado-Ekiti

Plain English Summary

Intestinal parasitic infections are one of the most significant public health problems globally. It affects approximately 3.5 billion people and causes over 450 million illnesses every year. Vegetables and fruits are considered to be vehicles that easily transmit parasites to humans. This study aimed to investigate the potential presence of intestinal parasites in certain vegetables available for sale in the Ado-Ekiti marketplaces. This study showed that vegetables sold in the selected markets in Ado-Ekiti Metropolis were contaminated with medically important parasites which are potential sources of disease

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transmission. Improved hygiene among the farmers, consumers, and vendors will be paramount in reducing the burden of intestinal parasite infection.

Background

Vegetables are the main sources of vitamins required by humans and animals. Leafy vegetables refer to the leafy part of a plant consumed by humans and animals (1). Leafy greens offer numerous health benefits, including reduced risk of several health conditions such as hypertension, obesity, heart disease, and mental retardation (2). In many parts of Nigeria, green leafy vegetable consumption has been widely accepted as components of regular meals for preparing stews and soups or in the form of special cuisines (3). The consumption of uncooked vegetables and fruits seems to be a convenient and beneficial means of obtaining nourishment. Nevertheless, it is worth noting that fresh vegetables and fruits have the potential to serve as significant reservoirs for food-borne pathogenic microbes, provided that they have been contaminated (4, 5).

Intestinal parasitic infections are widely distributed worldwide, endangering public health (6). Intestinal parasitic infections are one of the most significant public health problems globally, affecting approximately 3.5 billion people and causing over 450 million illnesses annually (7). Intestinal parasites have a high prevalence in poorer nations, likely attributed to substandard sanitation practices and insufficient adherence to personal hygiene protocols (8). Intestinal parasites are primarily transmitted by fecal-oral routes, mostly via ingestion with contaminated food and water or during direct hand-to-mouth contact (9).

In general, vegetables and fruits are considered to be vehicles that easily transmit parasites to individuals, especially when eaten raw or without peeling (9). Previous studies have shown that *Ascaris lumbricoides*, *Strongyloides stercoralis*, *Cryptosporidium spp*., *Entamoeba histolytica*, *Enterobius vermicularis*, *Giardia intestinalis*, *hookworm*, *Hymenolepis spp*., *Taenia spp*., *Trichuris trichuria*, and *Toxocara spp*., can infect humans who consume contaminated, uncooked, or improperly washed vegetables and fruits (10, 11).

Several studies have reported the parasitic contamination of fresh vegetables in many countries around the world, for example, Accra, Ghana (12), Arba Minch town, southern Ethiopia (6, 8), Khartoum state, Sudan (13), Benha, Egypt (14). Giardiasis, which is more common in children has a worldwide prevalence of about 1-30%. Ascaris is one of the commonest nematodes of man especially in tropical Africa, with a prevalence of about 40% in Enugu State. More recent studies in rural villages of Ebonyi state, southeast Nigeria, and other parts of Nigeria have corroborated this high prevalence of parasites isolated from edible fruits and vegetables. 40% contamination of a total of 250 samples of edible fruits and vegetables sold in markets in rural villages of Ebonyi state has also been reported (15). Kwara State, it was reported that 41% of a total of 250 samples were contaminated with the selected edible fruits and vegetables (16).

The common symptoms are as follows: abdominal pain, myositis, constipation, aneamia, anorexia, B12 deficiency, rectal haemorrhage, blindness, hematochezia, hemoptysis, dysuria, central nervous system impairment, chest pain, chills, chronic fatigue, colitis, coughing, diarrhoea, digestive disturbance, dizziness, fever, enlargement of various organs, headaches, vaginitis, jaundice, joint pain, weight loss due to malnutrition, weakness, immunodeficiency, nausea, vomiting, swelling of facial features, sweating, insomnia, skin ulcers, rectal prolapsed, mental problems, lung congestion, memory loss, night sweats, and muscle spasms (17).

Considering the association between food-borne parasitic infections and the ingestion of contaminated fresh vegetables, it is imperative to investigate the potential presence of intestinal parasites in certain vegetables available for sale in the Ado-Ekiti marketplace. A cross-sectional study was conducted to determine the parasites associated with widely ingested vegetables bought from certain markets, aiming to gather epidemiological and parasitological data on vegetables in the area

Materials and Methods

Study area

This study was carried out in Ado-Ekiti, the capital city of Ekiti State, Nigeria. It is the headquarters of the Ekiti Central senatorial district, in the southwest, of Nigeria. The total land area is 293 km^2. Ado Ekiti is the Ekiti state capital and a Local Government Headquarter in one of the sixteen Local Government Areas in Ekiti state. It lies within Latitude 7°10' and 7°45' north of the Equator and Longitudes 5°10' and 5°28' east of the Greenwich meridian (18). Ekiti State is a State in southwestern Nigeria, bordered to the north by Kwara State, to the northeast by Kogi State, to the south and southeast by Ondo State, and to the west by Osun State. Ekiti State was formed from a part of Ondo State in 1996 and has its capital as the city of Ado-Ekiti.

Sample size determination
The minimum sample size (N) was calculated using the qualitative variable formula for cross-sectional study as described by Ola-Fadunsin *et al*. (19).

Specimen collection
The vegetables used for this study were picked from four different major markets: Eriffun market, Oja-Oba market, Ureje market, and Shasha market; all located in Ado-Ekiti metropolis, Ekiti state from May to June 2023. These markets were put into consideration because they are the major food markets within Ado-Ekiti and most of the farmers convey their produce from their farmlands which may have been through different conditions like the farmers using animal waste or human waste as manure and so on.
The choices of vegetables used in this study were: Uziza leaf (*Piper guineense*), Water leaf (*Talinum triangulare*), Carrot (*Daucus carota*), Ewedu leaf (*Corchorus olitorius*), and Ugu leaf (*Telfairia occidentalis*). A total of 120 samples of vegetables were picked randomly from the above-mentioned markets. The vegetable vendors were selected through a systematic random sampling technique. From each market, 1 of the same vegetables were gotten from six different vendors and the same applied to all the vegetables across the four markets making a total of 24 of the same vegetables and an overall total of 120 vegetables across the four markets. The vegetables were purchased within the early hours of 8 am and 9 am. Each sample was collected and placed in plastic bags and labelled properly before transporting in a cold box to the Medical Laboratory Science Department, Afe Babalola University Ado-Ekiti, Ekiti State for parasitological examination. The procedures were carried out at a stable temperature and a biosafety cabinet was used.

Sampling analysis
The vegetables were washed separately in 150 ml of normal saline for the removal or elution of parasitic ova, larva, or cyst of helminth and protozoan parasites. After which the vegetables used were discarded into a hazardous trash can and the residue was left to sit overnight (20).
After the water from the washed vegetables was left overnight, a sieve was used to remove undesirable matter and the suspension was dispensed into the clean centrifuge tubes (21).
This method distinctly describes an experimental protocol of stripping the ova, cyst, or larva from the vegetable by leaving it in normal saline overnight and the substrate and concentrate were considered. (22). Each resultant suspension was transferred to a centrifuge tube using a sieve to remove debris. The tube was centrifuged at 2,000 rpm for five minutes. After centrifugation, the supernatant was decanted carefully without shaking. Then the sediment was agitated gently by hand to redistribute the parasitic stages. Finally, the sediment was examined under a light microscope using ×10 and ×40 objectives. The whole area under the coverslip was checked for eggs and larvae of parasites. The process was systematically repeated until the sediment in each centrifuge tube was examined.

Data Analysis
The data was analyzed using Statistical Package for Social Sciences (SPSS) version 23. The results were presented using frequency and percentages and shown in tables.

Results
Out of the 120 vegetable samples bought from four selected markets in Ado-Ekiti, 78 (65%) of the vegetables were positive for intestinal parasites.
Table 1 shows the total number of parasites observed in the vegetable types selected for this study. Ewedu leaf (*Corchorus olitorius*) 30 (38.5%) recorded the highest incidences of parasites seen in the vegetables while Uziza leaf (*Piper guineense*) and Carrot (*Daucus carota*) had the least with 5.1% each.

Table 1: Total number of parasites seen in the vegetables and the percentage

Vegetable(s)	Number of Parasites Detected	Percentage (%)
Ugu leaf (*Telfairia occidentalis*)	14	18%
Ewedu leaf (*Corchorus olitorius*)	30	38.5%
Uziza leaf (*Piper guineense*)	4	5.1%
Waterleaf (*Talinum triangulare*)	26	33.3%
Carrot (*Daucus carota*)	4	5.1%

Table 2 shows the parasite types found on vegetables in the four markets. *Giardia lamblia* and *Strongyloides stercoralis* were the most common parasites detected in the vegetable types in the Oja Oba market with a total of 8 each while hookworm had the least. Vegetables from the Eriffun market showed *Strongyloides stercoralis*, *Ascaris lumbricoides,* and *Entamoeba histolytica* had the highest prevalence with a total of 4 each, while *Trichuris*

trichuria had the lowest. Vegetables in the Shasha market showed *Strongyloides stercoralis* had the highest prevalence of all the vegetables totaling 14 while Balantidium coli and hookworm had the lowest with 2 parasites each. Vegetables in the Ureje market showed *Strongyloides stercoralis* had the highest prevalence of all the vegetables with 8 parasites while *Balantidium coli* had the lowest with 2 parasites.

Table 2: Types and frequency of parasites found on vegetables in the different markets and the number

Markets	Vegetables	Types of Parasites	No of Parasites
	Ugu *(Telfaira occidentalis*	*Ascaris lumbricoides*	2
		Giardia lamblia	2
	Ewedu (*Corchorus olitorius*)	*Strongyloides stercoralis*	4
		Giardia lamblia	2
		Hookworm	2
Oja Oba	Uziza (*Piper guineense*)	Nil	Nil
	Waterleaf (*Talinum triangulare*)	*Strongyloides stercoralis*	4
		Ascaris lumbricoides	2
		Giardia lamblia	4
		Hookworm	2
	Carrot (*Daucus carota*)	*Nil*	Nil
	Ugu (*Telfairia occidentalis*)	*Ascaris lumbricoides*	2
		Entamoeba histolytica	2
	Ewedu (*Corchorus olitorius*)	*Ascaris lumbricoides*	2
Eriffun		*Entamoeba histolytica*	2
		Trichuris trichuria	2
	Uziza (*Piper guineense*)	*Nil*	Nil
	Waterleaf (*Talinum triangulare*)	*Strongyloides stercoralis*	4
	Carrot (*Daucus carota*)	*Nil*	Nil
	Ugu (*Telfairia occidentalis*)	*Strongyloides stercoralis*	2
		Giardia lamblia	2
	Ewedu (*Corchorus olitorius*)	*Strongyloides stercoralis*	4
		Giardia lamblia	4
		Balantidium coli	2
Shasha	Uziza (*Piper guineense*)	*Strongyloides stercoralis*	2
	Waterleaf (*Talinum triangulare*)	*Strongyloides stercoralis*	4
		Giardia lamblia	2
		Hookworm	2
	Carrot (*Daucus carota*)	*Strongyloides stercoralis*	2
	Ugu (*Telfairia occidentalis*)	*Strongyloides stercoralis*	2
	Ewedu (*Corchorus olitorius*)	*Balantidium coli*	2
		Giardia lamblia	4
Ureje	Uziza (*Piper guineense*)	*Strongyloides stercoralis*	2
	Waterleaf (*Talinum triangulare*)	*Strongyloides stercoralis*	2
	Carrot (*Daucus carota*)	*Strongyloides stercoralis*	2

Table 3 shows a cross-tabulation of the prevalence of the parasites in the various markets and types of vegetables. The Shasha market had the highest prevalence with 26 parasites, followed closely by the Oja Oba market which had a total of 24 parasites. Gryphon and Ureje markets had the lowest prevalence with 14 parasites each.

Table 3: Frequency of vegetable contamination according to markets

Vegetables	Oja Oba	Eriffun	Shasha	Ureje
Ugu (*Telfairia occidentalis*)	4 (16.7%)	4 (28.6%)	4 (15.4%)	2 (14.3%)
Ewedu (*Corchorus olitorius*)	8 (33.3%)	6 (42.8%)	10 (38.4%)	6 (42.8%)
Uziza (*Piper guineense*)	0 (0%)	0 (0%)	2 (7.7%)	2 (14.3%)
Waterleaf (*Talinum triangulare*)	12 (50%)	4 (28.6%)	8 (30.8%)	2 (14.3%)
Carrot (*Daucus carota*)	0 (0%)	0 (0%)	2 (7.7%)	2 (14.3%)
Total	24	14	26	14

Table 4 shows the prevalence of parasites found in vegetables in all the markets. *Strongyloides stercoralis* 34 (43.6%) had the highest prevalence while the least was *Trichuris trichiura* 2 (2.6%).

Table 4: Prevalent rate of parasites

Parasites	No of Parasites	% of Parasites
Ascaris lumbricoides	8	10.3%
Entamoeba histolytica	4	5.1%
Trichuris trichuria	2	2.6%
Strongyloides stercoralis	34	43.6%
Giardia lamblia	20	25.6%
Hookworm	6	7.7%
Balantidium coli	4	5.1%

Discussion

Intestinal parasite infections have received little attention in developing countries. These organisms infest vegetables while still in the field and are usually transmitted by contaminated wash water and spread by ineffective hygienic practices (8, 23). In this study, a total of 120 vegetables were sampled from four major markets in Ado-Ekiti, Ekiti State, which include Oja Oba, Eriffun, Ureje, and Shahsa markets. The vegetables were examined for intestinal parasite contamination.

The vegetables sampled were Ugu (*Telfairia occidentalis*), Ewedu (*Corchorus olitorius*), Uziza (*Piper guineense*), Waterleaf (*Talinum triangulare*) and Carrot (*Daucus carota*). Out of the 120 samples examined, 78 (65%) of the vegetables were positive for intestinal parasites which was higher than a previous study carried out in the Ifaki-Osin route in Ekiti State (24). The prevalent rates are also higher than other reports from Illorin (42%), and Abuja (33.3%) (25, 26). The prevalent rate in this study is lower than a study carried out in Jos South L.G.A, Plateau State where the prevalent rate was 82.69% (27). The difference in the prevalence rate could be a result of the geographical region. A previous study carried out at Ibadan City, Southwest, Nigeria by Adejayan and Olajumoke showed a low prevalence rate of 11.6% (28). This could be because the degree of contamination varies according to vegetables. Ewedu leaf (*Corchorus olitorius*) recorded the highest with 30 (38.5%) parasite contamination which was different from other studies carried out in some markets in Abuja where waterleaf recorded the highest contamination of 80% (26) and another study carried out in Yenegoa recorded carrot with the highest contamination, 51.22% (29). This study showed that Uziza leaf (*Piper guineense*) and Carrot (*Daucus carota*) recorded the lowest parasite contamination 4 (5.1%) as shown in Table 1.

Seven different types of parasites were isolated from 120 vegetables from the four different markets; these parasites include *Strongyloides stercoralis* 34 (43.6%) with the highest prevalence which is different from studies carried out by Akinseye *et al* (22). and Mogaji *et al*. (23). *Giardia lamblia* 20 (25.6%), *Ascaris lumbricoides* 8 (10.3%), *Hookworm* 6 (7.7%), *Entamoeba histolytica* 4 (5.1%), *Balantidium coli* 4 (5.1%) and *Trichuris trichuria* 2 (2.6%). In this study, the Shasha market recorded the highest number of parasitic contaminations with 26, followed by the Oja Oba market with 24. The Eriffun and Ureje markets recorded the lowest with 14 parasitic contaminations each. *Strongyloides stercoralis* was a common parasite observed from all four markets while *Balantidium coli* was observed only at the Ureje market.

The prevalent rate of these parasites could be attributed to a lack of awareness of the need for prevention and control of parasitic diseases and

the poor sanitary practices among vegetable farmers and vendors. The use of human and animal faeces as manure in farms is another probable way for parasitic contamination of vegetables. Other influential factors may be a result of epidemiological factors such as climatic conditions of the region, type of water and fertilizer used for growing vegetables, and contamination after harvest. Some vegetables survive in the northern part of Nigeria due to the favourable weather conditions and such vegetables are not grown in the south. The contamination of irrigation water and municipal wastewater by human and animal waste and soil contaminated with human and animal faeces is also a major threat to vegetable contamination. The level of contamination of irrigation water, manure, and soil in which green vegetables are cultivated on these farms was not assessed. Further studies are also needed to determine the risk factors associated with vegetable contamination in the study. Some of these vegetables were displayed in the markets without washing as observed in Shasha which is a bush market located at the entrance of Ado-Ekiti, from Ikere Local Government Area of Ekiti State.
This study was able to indicate the level of vegetable contamination in Ado-Ekiti, Ekiti state but the limitation was the inability to cover other markets within the State due to funding.

Conclusion
This study showed that vegetables sold in the selected markets in Ado-Ekiti Metropolis were contaminated with medically important parasites which are potential sources of disease transmission. This study was carried out during May and June which is a peak period of the rainy season in the southwestern part of Nigeria. The season had an impact on the results obtained in this study as rain is a medium for washing wastewater, and human and animal waste into the soil and water sources. These findings have shown that producers, marketers, and consumers of these fruits and vegetables stand a high risk of being infected with intestinal parasites. Therefore, improved hygiene among the farmers, consumers, and vendors will be paramount in reducing the burden of intestinal parasite infection.
There is a need for improved surveillance systems on food-borne pathogens, food products through adequate vegetable farming procedures, and improved transportation and storage facilities in various market destinations. The sources of contamination of these vegetables need to be investigated to enable interventions at the farm level to reduce levels of contamination.

List of Abbreviations
Nil.

Declarations
Ethics considerations and consent to participate
Not applicable

Consent for publication
All the authors gave consent for the publication of the work under the Creative Commons Attribution-Non-Commercial 4.0 license. We otherwise convey all copyright ownership, including all rights incidental thereto, exclusively to the journal when published.

Availability of data and materials
The datasets used and/or analyzed in this study are available from the corresponding author upon reasonable request.

Competing interests
The authors have no conflicts of interest to declare.

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No fund was generated from any external organization for this research.

Author Contributions
ECP and HMA were in charge of the project's conceptualization and design. ECP carried out the process of data curation. ECP conducted a formal analysis. ECP, ENA and NME carried out the investigation. The authors presented the methodology. The project administration was carried out by ECP, HMA, AVA, and EF. ECP, HMA, EOO, and EF obtained resources. The software was obtained by HMA. The supervision was conducted by ECP, HMA and NME. The validation process was carried out by ECP, HMA, and EF. The first draft of the writing was done by ECP. The task of reviewing and editing the writing was undertaken by ECP and HMA.

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References
1. Randhawa MA, Khan AA, Javed MS, Sajid MW. Green Leafy Vegetables: A Health Promoting Source. Handbook of Fertility. 2015;205–20. https://doi.org/10.1016/b978-0-12-800872-0.00018-4.
2. Morris MC, Wang Y, Barnes LL, Bennett DA, Dawson-Hughes B, Booth SL. Nutrients and bioactives in green leafy vegetables and cognitive decline. Neurology. 2017 Dec

20;90(3):e214–22. https://doi.org/10.1212/wnl.0000000000004815.
3. Umerah NN, Nnam NM. Nutritional Composition of Neglected Underutilized Green Leafy Vegetables and Fruits in South East Geo-political Zone of Nigeria. Asian Food Science Journal. 2019 Aug 9;1–17. https://doi.org/10.9734/afsj/2019/v11i230058.
4. Herman KM, Hall AJ, Gould LH. Outbreaks attributed to fresh leafy vegetables, United States, 1973–2012. Epidemiology and Infection [Internet]. 2015 Feb 20 [cited 2019 May 5];143(14):3011–21. https://doi.org/10.1017/s0950268815000047.
5. Bouzid M, Kintz E, Hunter PR. Risk factors for Cryptosporidium infection in low and middle-income countries: A systematic review and meta-analysis. Ajjampur SS, editor. PLOS Neglected Tropical Diseases. 2018 Jun 7;12(6):e0006553. https://doi.org/10.1371/journal.pntd.0006553.
6. Bekele F, Tefera T, Biresaw G, Yohannes T. Parasitic contamination of raw vegetables and fruits collected from selected local markets in Arba Minch town, Southern Ethiopia. Infectious Diseases of Poverty. 2017 Mar 7;6(1). https://doi.org/10.1186/s40249-016-0226-6
7. Elmonir W, Elaadli H, Amer A, El-Sharkawy H, Bessat M, Mahmoud SF, et al. Prevalence of intestinal parasitic infections and their associated risk factors among preschool and school children in Egypt. PloS One. 2021;16(9):e0258037. https://doi.org/10.1371/journal.pone.0258037
8. Daryani A, Ettehad GH, Sharif M, Ghorbani L, Ziaei H. Prevalence of intestinal parasites in vegetables consumed in Ardabil, Iran. Food Control. 2008 Aug;19(8):790–4. https://doi.org/10.1016/j.foodcont.2007.08.004.
9. Hajare ST, Gobena RK, Chauhan NM, Eriso F. Prevalence of Intestinal Parasite Infections and Their Associated Factors among Food Handlers Working in Selected Catering Establishments from Bule Hora, Ethiopia. Napoli E, editor. BioMed Research International. 2021 Aug 20;2021:1–15. https://doi.org/10.1155/2021/6669742.
10. Auta T, Bawa J, Suchet C. Parasitic Contamination of Common Fresh Fruits and Vegetables Sold in Markets within Dutsin-Ma Town, Katsina State, Nigeria. Journal of Advances in Biology & Biotechnology. 2017 Jan 10;14(2):1–8. https://doi.org/10.9734/jabb/2017/33010.
11. Li J, Shi K, Sun F, Li T, Wang R, Zhang S, et al. Identification of human pathogenic Enterocytozoon bieneusi, Cyclospora cayetanensis, and Cryptosporidium parvum on the surfaces of vegetables and fruits in Henan, China. International Journal of Food Microbiology. 2019 Oct;307:108292. https://doi.org/10.1016/j.ijfoodmicro.2019.108292.
12. Duedu KO, Yarnie EA, Tetteh-Quarcoo PB, Attah SK, Donkor ES, Ayeh-Kumi PF. A comparative survey of the prevalence of human parasites found in fresh vegetables sold in supermarkets and open-aired markets in Accra, Ghana. BMC Research Notes. 2014 Nov 25;7(1). https://doi.org/10.1186/1756-0500-7-836.
13. Mohamed MA, Siddig EE, Elaagip AH, Edris AMM, Nasr AA. Parasitic contamination of fresh vegetables sold at central markets in Khartoum state, Sudan. Annals of Clinical Microbiology and Antimicrobials. 2016 Mar 11;15(1). https://doi.org/10.1186/s12941-016-0133-5.
14. Eraky MA, Rashed SM, Nasr MES, El-Hamshary AMS, Salah El-Ghannam A. Parasitic Contamination of Commonly Consumed Fresh Leafy Vegetables in Benha, Egypt. Journal of Parasitology Research. 2014;2014:1–7. https://doi.org/10.1155/2014/613960.
15. Elom M, Eze U. Prevalence of geohelminths on edible fruits and vegetables cultivated in rural villages of Ebonyi State, South East Nigeria. American Journal of Food and Nutrition. 2012 Sep;2(3):58–64. https://doi.org/10.5251/ajfn.2012.2.3.58.64.
16. Ogbolu DO, Alli OAT, Ogunleye VF, Olusoga-Ogbolu FF, Olaosun I. The presence of intestinal parasites in selected vegetables from open markets in southwestern Nigeria. Afr J Med Med Sci. 2009;38(4):319-24.
17. Cox, F.E.G. (2002). History of Human Parasitology. *Clinical Microbiology Reviews*. 2002, 15(4): 595–612. https://doi.org/10.1128/cmr.15.4.595-612.2002.
18. Owolabi JT. Geographical analysis of green belt on urban climate of Ado-Ekiti. Am J Res Commun. 2020;8(9):1-14.
19. Ola-Fadunsin SD, Adebanjo AO, Abdullah DA, Hussain K, Sanda IM, Rabiu M, Ganiyu IA, Elelu N, Aiyedun JO, Oludairo OO. Epidemiology and public health implications of parasitic contamination of fruits, vegetables, and water in Kwara Central, Nigeria. Ann Parasitol. 2022;68(2):339-352 https://doi.org/10.17420/ap6802.440.
20. Erdogˇrul Ö, Şener H. The contamination of various fruits and vegetables with Enterobius vermicularis, Ascaris eggs, Entamoeba histolyca cysts and Giardia cysts. Food Control. 2005 Jul;16(6):557–60.

https://doi.org/10.1016/j.foodcont.2004.06.016.
21. Alemu G, Nega M, Alemu M. Parasitic Contamination of Fruits and Vegetables Collected from Local Markets of Bahir Dar City, Northwest Ethiopia. Research and Reports in Tropical Medicine. 2020 Mar;Volume 11:17–25. https://doi.org/10.2147/rrtm.s244737.
22. Cheesbrough, M. (2006). *District Laboratory Practice in Tropical Countries*. Cambridge University Press.
23. Akinseye, J.F., Buru, A.S., Kayode, A.I. and Adedokun, A.R. (n.d.). *International Journal of Health Sciences and Research*. [online] www.ijhsr.org. Available at: https://www.ijhsr.org/IJHSR_Vol.7_Issue.6_June2017/IJHSR_Abstract.012.html [Accessed 28 Feb. 2024].
24. Mogaji HO, Ishola AY, Adekunle ON, Adekoya MA, Oluwafemi FS, Ajayi OA, et al. Parasitic Contamination on Raw Vegetables Sold in Selected Open Markets in Ekiti, Southwest Nigeria. Pan African Journal of Life Sciences. 2021 Dec 25;5(3):342–8 https://doi.org/10.36108/pajols/1202.50.0360
25. Fumilayo AJ, Mosunmola OJ, Kayode AI, Adedokun AR, Zagi HT, Buru AS. Intestinal Parasites Isolated in Vegetables Sold in the most Important Markets within the Ilorin Metropolis. *Journal of Tropical Diseases & Public Health*, 2020, 8(1)1-8. https://doi.org/10.35248/2329-891x.19.8.342.
26. Igbokwe CC, Abarike M, Chukwu JA, Ezaka E.I, Osunkwo, UA. Parasitic Contamination of Fruits and Vegetables Collected from Selected Local Markets in Abuja, North Central Nigeria. *The International Journal of Science & Technology*. 2020, 8(12). https://doi.org/10.24940/theijst/2020/v8/i12/st2012-014.
27. Ozor JE, Amarachi JN, Kinjir H, Musa A, Fador NG, Orshio AD, et al. Assessment of Parasitic Contaminations of Commonly Consumed Vegetables Sold in Two Markets in Jos South L.G.A, Plateau State. International Journal of Innovative Science and Research Technology (IJISRT). 2024 Jun 13;2788–96. https://doi.org/10.38124/ijisrt/IJISRT24MAY323
28. Adejumoke A, Morenikeji O. Prevalence of intestinal parasites in vegetables sold in major markets in Ibadan city, south-west Nigeria. Global Journal of Pure and Applied Sciences. 1970 Jan 1;21(1):7–12 https://doi.org/10.4314/gjpas.v21i1.2
29. Amawulu E, Sampson A, Henry AI. Fruits consumption pattern and its implication on parasite transmission in Yenagoa Metropolis, Nigeria. J Trop Dis. 2019;7:302. https://doi.org/10.4172/2329-891X.1000302